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B. L. Feringa

*The author presented here has recently published his **25th article** since 2000 in Angewandte Chemie:* "Light-Induced Control of Protein Translocation by the SecYEG Complex": F. Bonardi, G. London, N. Nouwen, B. L. Feringa, A. J. M. Driessen, *Angew. Chem.* **2010**, *122*, 7392–7396; *Angew. Chem. Int. Ed.* **2010**, *49*, 7234–7238.

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Education:	1974 Undergraduate studies, University of Groningen 1978 PhD with Prof. Dr. Hans Wijnberg, University of Groningen 1978–1984 Research Scientist Royal Dutch/Shell, Shell Research Laboratories Amsterdam (The Netherlands), Shell Biosciences (UK)
Awards:	**1997** Pino Gold Medal of the Società Chimica Italiana; **2000–2001** Novartis Chemistry Lectureship Award; **2003** Körber European Science Award; **2003** The Ramabrahman and Balamani Guthikonda Award (Columbia University, USA); **2004** Spinoza Prize (Netherlands); **2004** Elected Foreign Member of the American Academy of Arts and Sciences; **2005** Solvias Ligand Contest Award (jointly with J. Hartwig); **2005** Prelog Gold Medal for Stereochemistry (ETH Zürich, Switzerland); **2006** Elected Member of the Royal Netherlands Academy of Sciences; **2007** James Flack Norrish Award in Physical Organic Chemistry from the American Chemical Society; **2008** Paracelsus Award of the Swiss Chemical Society; **2008** Knighted by Her Majesty the Queen; **2009** President of the Bürgenstock Conference; **2009** Chirality Medal
Current research interests:	We exploit the full potential of synthetic chemistry to create new structures, functions, and chemical systems. Inspired by nature's principles of molecular recognition, assembly, catalysis, transport, and motion, the goal is to design novel functional (supra)molecular materials as well as to develop new catalysts and synthetic methodologies. Two major areas of interest can be distinguished: 1) Systems chemistry and molecular nanosciences with particular emphasis on the control of dynamics including switches, translational, and rotary molecular motors, amplification, chirality transfer, and multifunctional nanosystems. 2) Synthesis and catalysis with a focus on the development of asymmetric catalysis and application of novel catalytic methods in natural-product synthesis and biomolecular chemistry. Chirality is a principal theme in the research program.
Hobbies:	Farming, ice-skating, skiing, history

If I could be anyone for a day, I would be … Leonardo da Vinci.

My greatest achievement has been … the design of a molecular motor.

I am waiting for the day when someone will discover … the molecular basis for the functioning of our brain.

Chemistry is fun because … it combines passion, discovery, design, art, and application.

If I could have dinner with three famous scientists from history, they would be … Pasteur, van 't Hoff, and Woodward.

My biggest motivation is … the joy associated with discovery, beauty, and function of the molecular systems that we can design.

The secret of being a successful scientist is … to embark on an adventure with nature together with your students and to work on problems for which you do not know the answers yet.

The best advice I have ever been given … was to work on something novel and important.

The worst advice I have ever been given … was that the particular chemistry problem in question would be too complicated to study.

If I could be a piece of lab equipment, … I would be a stir plate.

My favorite piece of music is … Dvořák, "From the New World".

The most significant advances in chemistry in the last hundred years have been … nitrogen fixation and antibiotics.

The biggest challenge facing chemists is … to build "artificial life" and to provide the fundamental scientific breakthroughs that will lead to sustainable materials and processes for our future.

Young people should study chemistry because … you can invent a "new world" on your own.

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How is chemistry research different now than it was at the beginning of your career?

As a synthetic chemist, despite all the advances in computation, I still design most of my new molecules by using chalk and a blackboard. The major differences are the speed of making new materials and getting the physical data; compared to 25 years ago, the lab is now full of the most sophisticated equipment and in particular the new chromatography, NMR spectroscopy, MS, and surface analysis techniques make a huge difference. Catalysis has also greatly influenced the art of chemical synthesis and another significant development is the change from the synthesis of molecules to the design of functions. Of course there has been a tremendous shift of the frontiers of our discipline to the chemistry–biology and the chemistry–materials science interface. Molecular biology methods and surface science techniques are now routinely used in many chemical laboratories including our own.

Has your approach to chemistry research changed since the start of your career?

The basis still is the combination of molecular design and synthesis with in-depth physical organic studies of mechanism and function, but there has been a significant change toward increased complexity and chemical systems in our work. Already in the 1990s we realized that making a molecule was often not enough and we had to consider the key problem in terms of a systems approach. This approach includes, besides our ability to synthesize new molecules, the precise control of function, organization, interfacial phenomena, hierarchical levels, and control of dynamics. As a consequence of this multidisciplinary approach you will now also find young researchers with a physics or biochemistry background in my labs.

Has your approach to publishing your results changed since the start of your career?

Not really, besides perhaps to also publish in physics and materials science journals.

What do you think the future holds for your field of research?

For chemistry in general the future is extremely bright. Many of the key issues related to energy, health, food, sustainable materials, and processes, just to name a few with major impacts for society and economy, arguably will not be solved without major breakthroughs in chemistry. At the dawn of the 21st century it has already been proclaimed to become the century of biology. But to me it appears that the basic structures, functions, and processes in the complex systems of life are chemistry based, so 50 years from now it may well be molecular sciences in all their complexity that hold the torch. In my own research program it is particularly thrilling to face the challenge of out-of-equilibrium dynamic molecular systems and to study replication and amplification mechanisms in the context of chembiogenesis.

Have you changed the main focus of your research throughout your career and if so why?

The main focus of my research has always been stereochemistry. Not only is chirality an intrinsic feature of life on earth but it is also associated with multiple facets of chemistry that range from catalysis to drug action and liquid crystal devices. Still so many aspects of chirality are poorly understood; for instance, after more than 40 years of phantastic advances in asymmetric catalysis it is still not possible to predict the enantioselectivity of a new transformation from scratch! In parts of our research program the focus has changed several times, for example from solution to surfaces or from molecules to multicomponent supramolecular systems. The reason is that we had to solve a specific problem; as an example, we were only able to build our 'nano windmill park', which comprises a monolayer of unidirectional light-driven molecular motors, and prove its functioning by learning all the techniques for surface assembly and characterization. This change also meant installing and operating all the new facilities required to perform this research, ranging from lasers to STM and AFM.

What has been your biggest influence/motivation?

The sheer joy of discovery and being able to share your passion with bright young students is my main motivation. Perhaps the power of chemistry in not only understanding, but also creating, making molecules and materials that never existed before and that sometimes serve a tremendously rewarding purpose (e.g. a life-saving drug) has influenced me a lot. We often ask nature the questions "why" and "how" but I greatly enjoy also to ask: "why not?"

What advice would you give to up-and-coming scientists?

Choose important problems in chemistry and do not be afraid to enter new territory. But perhaps the first and foremost prerequisite is that one is curious and willing to embark on an adventure with molecules. Secondly, show perseverance and do not give up to easily. I know that there are scientists who like to work on questions for which they know the answer from the very start. I am convinced that it is more interesting to work on challenges that you do not know the answer to. It is extremely important to be a little daring and not to look too much at what most senior colleagues are doing. Go your own way! We all build of course on what has been accomplished by our heroes before us, but you

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must never forget that there are so many fantastic questions and challenges around. Pick something that can make an impact!

What is the secret to publishing so many high-quality papers?

I am not sure at all if there is a secret. In case there is, perhaps it is my love for stereochemistry, the chiral looking glass to view molecules with; nature often does give you the feeling of being in wonderland.

My 5 top papers:

1. "Light-driven monodirectional molecular rotor": N. Koumura, R. W. J. Zijlstra, R. A. van Delden, N. Harada, B. L. Feringa, *Nature* **1999**, *401*, 152 – 155.
   The first example of a molecular motor that can undergo continuous rotary motion by using light as an energy source is reported. The paper set the stage for a whole new development toward light- and chemically driven molecular motors and dynamic nonequilibrium systems driven by energy input.
2. "Molecular machines: Nanomotor rotates microscale objects": R. Eelkema, M. M. Pollard, J. Vicario, N. Katsonis, B. Serrano Ramon, C. W. M. Bastiaansen, D. J. Broer, B. L. Feringa, *Nature*, **2006**, *440*, 163.
   We demonstrated that a nanoscale molecular motor can—albeit indirectly—move a microscale object. It was a delight to show that a motor could induce visible motion. The transmission of molecular dynamics and organization along different hierarchical levels was the start for several new approaches toward dynamic supramolecular systems.
3. "DNA-based Asymmetric Catalysis": G. Roelfes, B. L. Feringa, *Angew. Chem.* **2005**, *117*, 3294 – 3296.
   The exciting observation that the chiral information embedded in DNA could be transferred in catalysis, thus giving absolute levels of stereocontrol in a variety of transformations in water is reported in this paper. Many approaches to DNA-based catalysis have followed in recent years.
4. "Copper-catalyzed conjugate addition of Grignard reagents to cyclic enones": B. L. Feringa, R. Badorrey, D. Peña, S. R. Harutryunyan, A. J. Minnaard, *Proc. Natl. Acad. Sci. USA* **2004**, *101*, 5834 – 5838.
   After 15 years we finally were able to tame the elusive Grignard reagents for catalytic conjugate additions. This transformation and the related copper-catalyzed allylic substitution have already found widespread use among other research groups in total synthesis.
5. "Enantioselective Conjugate Addition of Dialkylzinc Reagents to Cyclic and Acyclic Enones Catalyzed by Chiral Copper Complexes of New Phosphorus Amidites": A. H. M. de Vries, A. Meetsma, B. L. Feringa, *Angew. Chem.* **1996**, *108*, 2526 – 2528; *Angew. Chem., Int. Ed. Engl.* **1996**, *35*, 2374 – 2376.
   The introduction of unique monodentate phosphoramidite chiral ligands for catalysis allowed us to develop the first catalytic conjugate addition of organozinc reagents with near absolute levels of stereocontrol, but also initiated the development of dozens of catalytic asymmetric transformations based on phosphoramidites in the subsequent years.

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